Stat Mech 8. (Sathish) . 27/11/08 .

$$T = \left(\frac{\partial E}{\partial S}\right)_{V,N} = T(S,V,N) .$$

$$P(S,V,N) = \left(\frac{\partial E}{\partial V}\right)_{S,N}$$

Equation of state - eliminate S & relate P, T, V, N, $P = P(T,V,N)$.

- don't often do things in this way.

Thus for fixed N, only two quantities for macro state of the particles.

Summary : $dE = TdS - PdV + \mu dN$.

Statistical mechanics → statistical thermodynamics

Now: classical thermodynamics

Axioms, based on experiment, to derive everything else.

Good at giving interrelationships between different thermodynamical quantities.

Zeroth Law ① Concept of temperature makes sense.

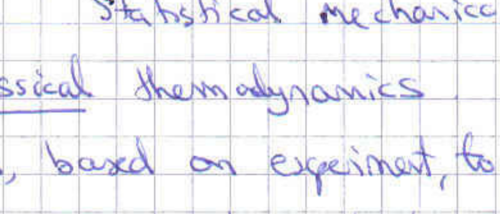
$A \sim B \quad B \sim C \Rightarrow A \sim C$ (equilibrium.

$A \sim B \Leftrightarrow A, B$ have same temperature.

$$\frac{\overset{sd}{\Delta E}}{E} \sim \frac{1}{\sqrt{N}} .$$

② Can decide if things are in thermal equilibrium using temperature.

First Law.



piston. Pushing it in changes the temperature of the gas.

$$\text{Work} = F \cdot dx = \left(\frac{F}{A}\right) \cdot (dx \cdot A)$$

$$= -(\text{pressure of gas}) \cdot dV$$

E = energy, internal energy.

$$đE = \overset{\text{heat}}{đQ} - \overset{\text{work done by system}}{R}$$

$$R = -p\,dV .$$

note that work is done in opposite direction to P.

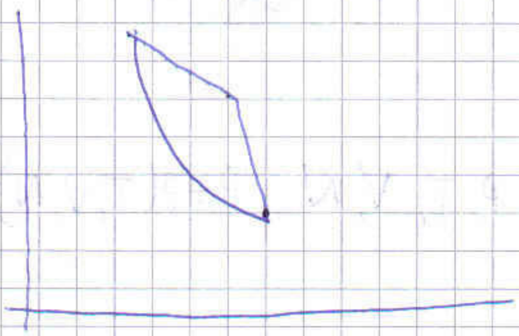
$$E = E(T,P,V)$$

So can convert heat to work and back.

"Energy is conserved" - cannot be created or destroyed.

$E = E(S, V, N)$

Second Law Entropy of an isolated system can only increase



Reversible change

$$\oint \frac{q}{T} = 0$$

$$\int_A^B \frac{q}{T} = S_B - S_A = \text{entropy}$$

Carnot engine